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NOVEMBER 30, 1987
CHEMICAL ENGINEERING

Chemists find missing piece in Antarctic ozone puzzle
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Chemical Engineering

NRC's Amundson Report mirrors a changing profession
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CHEMICAL & ENGINEERING
NEWS

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NOVEMBER 30, 1987

News of the Week

■ **After two-year delay, Indian government publishes results of medical studies on effects of methyl isocyanate on Bhopal disaster victims.** **Page 4**

■ **Testing by Kerr-McGee of fertilizer generated from treated radioactive wastes in Gore, Okla., is being monitored closely by both the company and local residents.** **Page 5**

■ **Permissible formaldehyde exposure limits are to be reduced by OSHA after years of petitioning by unions.** **Page 5**

■ **New journal on conducting ethical research is due for publication early next year.** **Page 6**

■ **New plant biotechnology research center in Albany, Calif., will concentrate on study of agriculturally important plant genes.** **Page 6**

Cover: Photo courtesy of Evans & Sutherland

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Business

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Government

Word to the wise from Chemical Manufacturers Association workshop: reduce waste now to limit pollution, improve public image, and avoid strictures of regulation. **Page 21**

American Medical Association takes ethical stand that physicians cannot refuse to treat AIDS virus-infected patients. **Page 22**

Science

Key puzzle of Antarctic ozone depletion is solved by two studies that link reactions on ice surfaces of cloud particles to creation of chlorine species that deplete ozone. **Page 25**

Books

"Fluorine: The First Hundred Years" covers the history of fluorine chemistry as well as recent advances in the field. **Page 28**

ACS News

Chemical industry mergers, acquisitions, and restructuring continue to have a marked impact on employment of chemists. **Page 35**

News Focus

National Research Council Committee, chaired by Neal R. Amundson, is set to issue report on research needs and opportunities at the frontiers of chemical engineering that reflects a profession in flux. **Page 7**

Chemical & Engineering News

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LETTERS

Two periodic tables

SIR: I could not resist the temptation to make a tongue-in-check observation concerning the possibility of a revised format for the periodic table.

During a basic organic chemistry course many years ago, we were exposed to the various systems of nomenclature. It was pointed out that the International Union of Pure & Applied Chemistry had brought sanity to the situation by introducing a highly organized method of naming compounds. When I asked why the other methods were still being used, now that IUPAC had straightened things out, I was told that for a while multiple systems would have to be used because the older nomenclature was deeply rooted in the literature and many older chemists had been trained in its use. What would be the guess as to how long future, first-year chemistry students will have to learn two periodic tables, for similar reasons?

Charles Feldmann
Cincinnati

Methanol to gasoline?

SIR: A. M. Souby's letter (C&EN, Aug. 17, page 3) was written with the breadth of perspective of a laser—a very narrow and uncompromising beam.

Souby's bias for gasoline comes from his long career with the great company, Exxon, whose dominant interest is hydrocarbon fuels. Another Exxon engineer, E. E. David, with a much broader background and perspective, noted (*Chem. Eng. Prog.*, Nov. 1981, page 22) that among its other recognized advantages, methanol is "the lowest cost liquid fuel available from coal," and in automobiles has "fewer emission problems."

Souby evidently thinks he developed—but doesn't detail—new polymers of methanol in deposits in his outboard motor. He did use methanol in this because of its well-known advantages, including much greater efficiency and horsepower from a given engine. However, he does qualify his lack of proof of new solids or semisolids produced from methanol when he considers the possibility that "much of these [polymer deposits] resulted from the castor oil [lubricant used] rather than the methanol."

He did recognize methanol's much greater efficiency with higher compression engines, and reports, "I don't know what the compression ratio was, but in a cylinder of 15 cu in the optimum volume remaining at the top of stroke [outboard motor], as I remember it, was about 30 cc though some racers reduced it to as low as 27 cc."

His methanol fuel was doctored with 5% each of benzene, toluene, and xylene, also some ether—and castor oil as a lubricant. After water was allowed to get in, he condemned methanol for a cloudy mixture; but after many years of consideration, "I am not sure now whether the cloudiness was the result of the hydrocarbons or of the castor oil coming out of solution because of the dilution with water." His latter judgment is correct—hydrocarbons alone would have formed a clean separate layer, castor oil is a partial emulsifier, not found in auto tanks. Nevertheless, he just assumed phase separation like the polymeric sludge would be caused by the methanol.

For some time he used "a lot of gasohol" in his automobiles and then some time after returning to using gasoline, he encountered "carburetor problems" that were "blamed on the use [many miles before] of fuels containing ethanol."

A person's prejudice cannot be changed, however absent may be any scientific, engineering, or quantitative studies or thinking. As to racing cars, personal interviews with drivers at the Indy 500 show that methanol has been the only fuel used in that race for decades because drivers insist that it is by far the safest fuel, least fire hazard; it is by far the most efficient fuel; it allows smaller, lighter engines and cars; and it gives longer life to these very expensive, very overworked engines.

One considerable advantage, not of particular concern to racing drivers, is that the exhaust is almost pollution free—and methanol is thus being specified for use in buses in many cities. Its high antiknock eliminates use of poisonous lead, or benzene, toluene, and xylene, which cause cancer. This BTX at up to 45% in our "super unleaded" gasoline adds 12 to 15 cents per gal cost at the pump, wastes 5% of the possible product, and some say threatens a greater hazard than lead by causing cancers and other ailments.

After 1 million miles of a test [Energy Sources Conference, *Am. Soc. Mech. Eng.*, 8, 91 (1987)] of some 15 cars of different foreign and domestic makes, using 87 octane gasoline against a blend of 10% methanol in the same gasoline, both fuels in the same usage in the same cars displayed the following:

Packaging Continues as Strong Growth Market for Plastics

Despite rosy outlook, concern is increasing over problem of solid waste disposal and pressure in some communities to ban all plastics packaging

Patricia L. Layman, C&EN London

Good growth lies ahead for plastics in packaging, but pressure on the packaging industry will intensify because of increasing concerns about waste disposal and biodegradation.

That's the conclusion reached at a plastics packaging conference held during Interplas '87, an international plastics and rubber exhibition, in Birmingham, England, earlier this month. The conference was sponsored by the Plastics & Rubber Institute, based in London.

Certainly a message of growth in the packaging industry would be good news to the industry's suppliers of plastics and nonplastics alike. As Geoffrey Barrett, a principal with Corporate Development Consultants Ltd. (CDC) in Bristol, England, pointed out, pulp and paper-making chemicals for packaging, in value terms, account for more than 3.5 million metric tons of material, worth about $2 billion. Other packaging materials include petrochemical feedstocks for polymers; chlorine and soda ash for polyvinyl chloride and glass; and various specialty supplies, such as solvents, resins and polymers, and pigments and dyes, for the formulation of adhesives, surface coatings, lacquers, and printing inks.

In fact, he adds, packaging is the largest single market for thermoplastics—"depending on which country you study, between 30 and 40% of thermoplastics consumption. Taking Western Europe as a whole, packaging accounts for 42% of thermoplastic consumption, and this percentage will remain little changed over the next decade."

The amount will fall slightly in Western Europe from 42% in 1985 to slightly more than 39% in 1995, as other end-use markets increase their consumption of thermoplastics. But packaging will still consume more than twice the next-largest single end use, building and construction, at 17%, Barrett says.

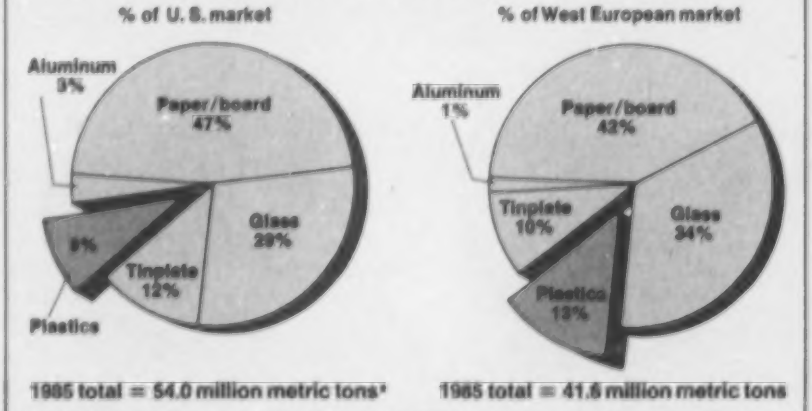
Earlier studies indicate that the U.S. consumes twice as much packaging material per capita as Western Europe, with a higher proportion of paper and board, tinplate, and aluminum, and a smaller proportion of glass or plastics, he says. There are also significant national differences among countries in Western Europe. Figures pulled together by CDC from various trade associations in West Germany, the U.K., France, and Italy indicate that for 1984, the most recent year available, West Germany has the highest proportion of tinplate packaging. The U.K. has the lowest percentage consumption of aluminum, and Italy the highest. And France, perhaps because of its high consumption of wine and mineral water, has the highest proportion of glass packaging.

Polyethylene terephthalate (PET) is the success story of the decade. Virtually unknown five years ago as a packaging form in Western Europe, it now accounts for more than 1 billion packs, mainly in Belgium, Italy, Luxembourg, the Netherlands, and the U.K., Barrett notes.

Some of the advantages of plastics for packaging, he predicts, will influence growth. For example, as food technologists develop alternatives to retorting for food processing, or as industry develops polymers or containers with controlled barrier properties, plastics for food and beverage containers will replace tinplate cans and glass jars and bottles.

Paper and board packaging probably will be least affected, he adds, particularly with the continued growth of cartons for liquids, at the

Plastics bigger portion of packaging in Europe than in U.S.



a C&EN estimate. Source: Corporate Development Consultants Ltd.

Local governments consider bans on plastic packaging

As landfill sites at a number of U.S. municipalities reach capacity, at least two local governments are considering a ban of plastic food wrapping.

The principal target of packaging laws now under consideration in New York's Suffolk County and Berkeley, Calif., is the polystyrene "clam shell" package that many fast-food restaurants use to wrap hamburgers, chicken, and other fare.

In addition, a New York state official, Richard M. Kessel, executive director of the State Consumer Protection Board, recently made public a letter he wrote to McDonald's chairman Fred L. Turner, asking that the giant food chain "discontinue" the use of polystyrene packaging "and instead expand its use of paper products made from recycled material."

Nearly everyone agrees that a waste disposal crisis exists. The case of the Mobro, a barge filled with 3100 tons of garbage that traveled up and down the Eastern seaboard this summer in search of a site at which it could legally dispose of its cargo, illustrates the crisis at hand.

But Ken Lane, assistant director for state government affairs for the Society of the Plastics Industry (SPI), says that disposable plastic food packaging is a very small part of a much larger waste problem. At least, he says, polystyrene packaging remains inert in a landfill and does not leach poisonous chemicals into groundwater as so-called biodegradable paper packaging does.

SPI publishes statistics that show that polystyrene packaging, including "clam shells," cups, plates, and other items, is the largest single end-use category for polystyrene. It accounted for more than 25%, or 1.1 billion lb, of all polystyrene used last year in the U.S.

Dow Chemical, a major supplier of polystyrene resins to packaging manufacturers, suggests that what municipalities need are comprehensive solid waste programs. Karl Kamena, Dow's director of government affairs, suggests that incinerating solid wastes and recovering the energy thus produced is one option. Recycling where it makes economic sense is another option. "It is pure foolishness," he says, to rely on degradable packaging. He agrees with Lane that degradable plastics and paper may form more harmful by-products and pose a greater danger to the environment than inert landfilled plastic waste.

Kamena points out that landfills "are designed to handle nondegradable waste. It is the degradable material that causes the problem." But he is not insensitive to the fact that landfill space is either unavailable or only available at a high cost in some areas of the country. He notes that landfill costs for communities in some areas of the U.S. have risen from $4.00 to $100 a ton.

Today the cost of burning waste to recover energy amounts to $35 a ton after the initial investment in a burn

expense of glass. And aluminum will grow largely at the expense of tinplate in beverage cans. In the U.S., 90% of beverage cans are aluminum; in Western Europe, however, aluminum accounts for only 30%.

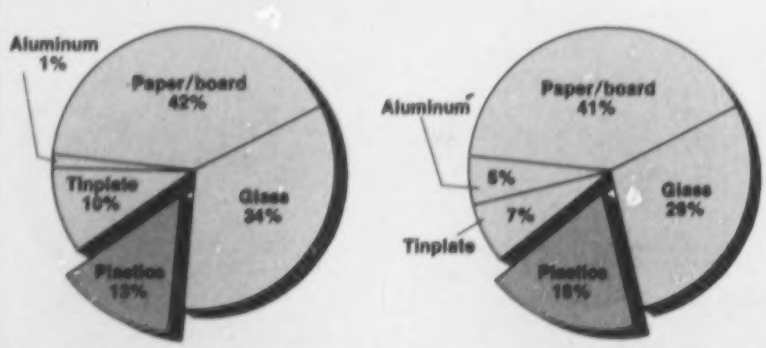
Meanwhile, there is certainly room for growth in plastics. More than 85% of all grocery products are still sold in standard forms of traditional packaging—glass, metal, and cardboard, says Sheila Clark, managing director of U.K.-based Packaging Innovation Group Ltd.

For packaging companies, she says, "plastics materials offer the chance to create the pack with a difference." That's important for the food industry, she adds, because the business as a whole is not expanding, so food companies must rely on increasing their market share at the expense of competitors. Innovating packaging is one way to do that, particularly when the packaging is "user friendly."

One such case is the ketchup squeeze bottles, introduced in Western Europe in 1986, following the introduction of bottles with high barrier properties, important for products with few or no preservatives. And, as the market for barrier bottles increases, so too will the demand for other improvements, she suggests—for example, the clarity of the pack or its ability to withstand wider temperature ranges, thereby enabling substitution of plastics for glass jars containing pasteurized products, or packs that can go directly from freezer to oven without distortion. The popularity of microwave ovens has already encouraged the growth of plastic packs.

That's not to say the potential is unlimited, however. Clark points out that when PET was first introduced, "it gave marketing managers the opportunity to sell twice the volume of product for relatively little increase in selling space. Two-L bottles grew to 3-L ones, which again increased purchase by 50%—but where does it go from there? Apart from value for money, the

Plastics use in packaging to grow in Europe



Source: Corporate Development Consultants Ltd.

facility, says Kamena. At that price, waste incineration could provide a more attractive long-term alternative to landfill. Two years ago, he says, 5% of municipal waste was burned to recover energy; today, about 10% of municipal wastes are burned. The only real impediment to more widespread use of garbage incineration is concern over dioxin emission levels. "We need a national standard on permissible levels of dioxin emission," Kamena says. The Environmental Protection Agency is currently establishing such levels, he adds.

However, New York's Suffolk County has gone ahead with its proposed plastic packaging ban, revising and expanding the bill (C&EN Aug. 24, page 7). According to Jay Schoenfeld, an aid to legislator Steven Engelbright, who first proposed the bill, revisions now include certain plastic wrapping bans for fruit, cheese, and meat.

Schoenfeld says that the bill still has more than the majority support it needs to pass. It is also unlikely to meet opposition from the recently elected county executive, Patrick Halpin, who as a county legislator sponsored Suffolk's pace-setting bottle return law years ago. The bill is likely to come up for a vote in December, he says.

Though New York state's legislature is not currently considering a ban of plastic food packaging, Kessel has indicated that such legislation could be proposed. However, a proposal is before the state legislature to tax nonrecyclable packaging. It would put a tax of up to 3 cents on nonrecyclable packaging for a given number of packaging units. Potentially recyclable materials would receive a 1-cent credit, and packaging made from recycled material an additional 1-cent credit. The tax would be waived for material meeting both criteria.

In fairness to fast-food vendor McDonald's, observers note the company is examining the packaging issue. It recently agreed to phase out the use of polystyrene foam packaging produced with chlorofluorocarbons, compounds believed to deplete atmospheric ozone. Competitor Burger King advertises that it uses biodegradable paper in its packaging.

In a separate issue affecting plastics disposal, the U.S. Senate's Environment & Public Works Committee approved a bill recently that would prohibit the disposal of plastic wastes in U.S. water and by U.S. ships anywhere. The bill, sponsored by Sen. Frank R. Lautenberg (D.-N.J.), implements the provisions of an international treaty recently passed by the Senate—the International Convention for the Prevention of Pollution from Ships.

Sen. Lautenberg's bill provides for a penalty of up to $50,000 for offenders and up to five years in prison. The bill also would require a study of the feasibility of recycling and production of biodegradable plastics.

Marc Reisch, New York

3-L pack has few other benefits," and 4- to 5-L packs even less.

Those 2- or 3-L packs have been highly important for the beverage industry, says Ian Roberts, of the packaging department of Coca-Cola Northern Europe, based in London. "In the past 10 years, the growth in the use of plastics for primary packages has been phenomenal."

But there are some significant challenges ahead that must be confronted if that record is to be maintained, he says, and if plastic packaging is going to continue its contribution to the growth of carbonated beverages.

"Perhaps the single most important way in which the plastics industry can help is to broaden the scope of our understanding of what plastics are, what they can do, and how we can realize their full potential to the benefit of our markets," Roberts says. Many involved in bottling have "only a very superficial knowledge of plastics technology, and as a result, pay scant attention to the full range of performance potential that plastics offer."

Furthermore, there is definitely a need for the plastics industry to define properties in terms that packagers understand. "Raw material data sheets do a very good job of defining basic properties, but often contain very little that is of any meaning or value to the package end user," Roberts adds.

The increased contact between plastics producer and package user is going to become even more important for the beverage industry, he suggests, because plastics conversion, unlike glass or can manufacture, lends itself very well to integration of package manufacture and filling. A number of beverage firms have already installed in-house package manufacturing facilities and this trend is likely to continue.

Despite all the good news about growth potential and market innovations and challenges, however, the problem of solid-waste disposal lurked in the background of the conference. For example, one of the session chairmen cited with concern one of the recent "Letters from America" broadcast by Alistair Cooke on the British Broadcasting Co., which lauded recent legislation in his hometown on the U.S.'s West Coast, to ban all plastics packaging. Most people at the conference felt that such a ban would be unworkable and eventually would be rescinded. And, of course, there were thoughts that the ban was in a part of the U.S. that is perceived as customarily doing odd things. But clearly the action shook them.

Coca-Cola's Roberts, for one, brought the issue squarely out front. His industry is particularly visible—and vulnerable. As he noted, "It is an unfortunate and uncomfortable fact of life that where the environmental lobby focuses on the impact of packaging on the environment, the frontline is usually beverage containers. So far in the U.K., we have felt very little practical effect of the onslaught of adverse opinion on nonreusable beverage packaging, but unless we adopt a much more positive stance we are all in danger of having our abilities to innovate effectively curtailed.

"If we fail to confront this issue, external controls will be applied to our activities, limiting our freedom to meet market demand, and ultimately stifling the innovation and growth which we seek for our businesses," he says. □

Competitive Moves by Industry Still Tough on Some Chemists

Michael Heylin, C&EN Washington

Many of the mergers, acquisitions, and other business restructurings that have characterized the chemical enterprise in recent years may have been justified in terms of assuring corporate survival in an increasingly competitive world. They have also helped bring about a more lean and mean chemical industry. But they are continuing to have a marked impact on the employment situation for chemists and chemical engineers, especially more experienced ones.

The details of some of these impacts are apparent in the latest report by the American Chemical Society's Committee on Professional Relations (CPR) on multiple terminations. The report covers 10 mass firings—which occurred between March 1984 and June 1987—involving about 250 chemists and chemical engineers. All but one involved chemists with more than 10 years of service.

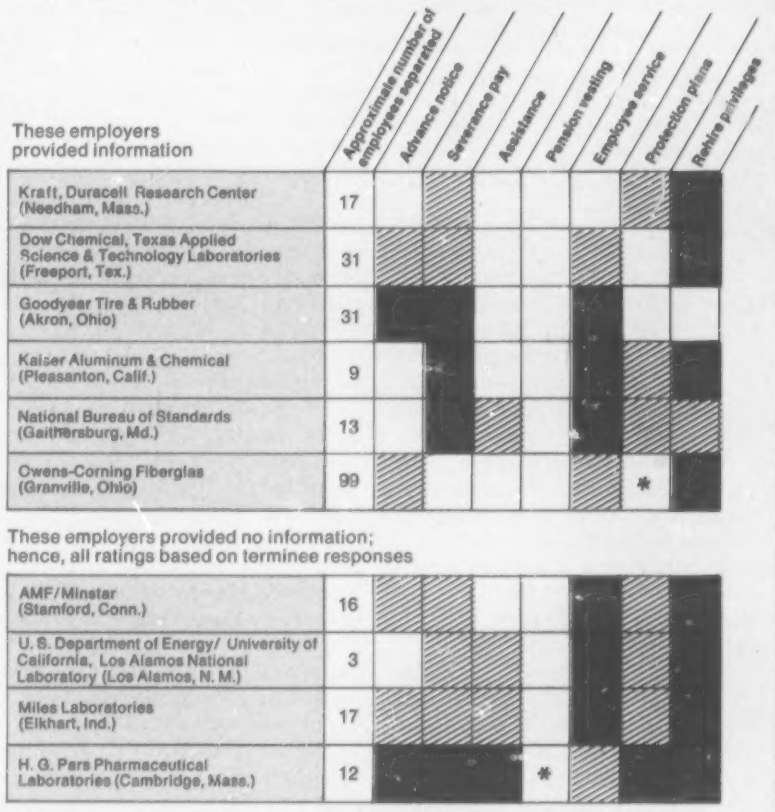
The largest of the cutbacks, involving 99 chemical professionals at Owens-Corning Fiberglas' technical center at Granville, Ohio, resulted from a potential takeover. The loss of 16 chemical jobs at AMF Inc. followed the acquisition of the firm by Minstar.

Major terminations at Dow Chemical and Goodyear Tire & Rubber, each affecting 31 chemical professionals, involved early retirement programs, as did the termination of 13 at the National Bureau of Standards. The other terminations covered in the report involved 17 chemical professionals at Kraft Inc., 17 at Miles Laboratories, 12 at H. G. Pars Pharmaceutical Laboratories, nine at Kaiser Aluminum & Chemical, and three at Los Alamos National Laboratory.

CPR defines a multiple termination as a situation in which the employment of three or more chemists or chemical engineers is terminated within a six-month period for reasons other than cause, completion of a contract, or continuing evidence of previously documented inadequate performance. All terminees do not have to have worked at the same location.

The new report is the 26th in a

Employer compliance with ACS guidelines


These employers provided information
Approximate number of employees separated
Advance notice
Severance pay
Assistance
Pension vesting
Employee service
Protection plans
Rehire privileges
Kraft, Duracell Research Center (Needham, Mass.) 17
Dow Chemical, Texas Applied Science & Technology Laboratories (Freeport, Tex.) 31
Goodyear Tire & Rubber (Akron, Ohio) 31
Kaiser Aluminum & Chemical (Pleasanton, Calif.) 9
National Bureau of Standards (Gaithersburg, Md.) 13
Owens-Corning Fiberglas (Granville, Ohio) 99
*
These employers provided no information; hence, all ratings based on terminee responses
AMF/Minstar (Stamford, Conn.) 16
U. S. Department of Energy/ University of California, Los Alamos National Laboratory (Los Alamos, N. M.) 3
Miles Laboratories (Elkhart, Ind.) 17
H. G. Pars Pharmaceutical Laboratories (Cambridge, Mass.) 12
*

* No information from any source.

☐ Employer met or exceeded guideline standard.

▨ Two or more individuals below guideline standard, but average experience better than "substantially below" criterion.

■ Employer was substantially below guideline standard, which is defined as follows:

- Advance notice–less than two weeks.
- Assistance–no assistance rendered.
- Severance pay–less than one week per year of service.
- Employee service–more than 40% of terminees had 10 or more years of service.
- Protection plans–no continuation of protection plans.

ACS guidelines

Advance notice. Four-week minimum.

Severance pay. Minimum is two weeks per year of service. Additional notice may be given, by mutual agreement, in lieu of severance pay.

Assistance. Efforts should be made to place terminee in another position within the organization, or terminee should be given assistance to find employment elsewhere.

Pension plan vesting. Full vesting after 10 years' service.

Employee service. Those with minimum of 10 years' service should not be terminated except for continued evidence of previously documented inadequate performance or cause.

Employee protection plans. Should be extended for a minimum of one month, plus two weeks for each year of employee service, following termination at same rate of contribution as before. Employee would have additional 31-day grace period.

Rehire privileges. Rehire privileges should be carefully explained to terminees.

series of such studies dating back to 1974. They compare the performance of employers having terminations with seven standards contained in ACS's Professional Employment Guidelines (PEG). These standards are concerned with employee service, severance pay, rehire privileges, pension vesting, assistance in obtaining new employment, extension of health and other protection plans, and advance notice.

CPR judges if employers have either complied with (or exceeded), violated, or "substantially" violated each standard. For the more than 230 terminations investigated in the 26 reports, standards were complied with (or exceeded) 43% of the time. They were violated 40% of time and "substantially" violated 17%. For the latest report, the compliance rate was 35%. This was a sharp downturn from the previous report, which showed a 59% compliance rate (C&EN, June 15, page 28).

In the latest report no employer complied with more than four of the seven standards. Miles Laboratories failed to meet six of them. H. G. Pars Pharmaceutical violated five of them "substantially."

In investigating mass terminations, CPR's Subcommittee on Professional Standards seeks data from both employers and terminees. About two thirds of employers have been willing to supply such data; six of the 10 did so for the latest report. Information from terminees is mostly obtained with the help of ACS local sections. The California, Columbus, and Northeastern sections were involved in data gathering for the latest report.

CPR asks individual society members to send information on terminations with which they are personally familiar to American Chemical Society, Office of Professional Relations, 1155—16th St., N.W., Washington, D.C. 20036. This office will provide, on request, copies of all CPR termination reports and a summary list of terminations over the past decade.

Of particular concern to CPR is the continued attrition of experienced employees. This situation is getting worse. The PEG guidelines state that those with a minimum of 10 years' service should not be terminated, except for continued incompetence, completion of a contract, or cause. But such long-service employees have been terminated in 42 of the 45 terminations covered in the past five CPR reports. For all 26 reports, this standard has been complied with only 22% of the time.

An employer is deemed by CPR to have "substantially" violated the employee service standard if 40% or more of those terminated had 10 or more years of service. This has happened in 40% of the cases investigated to date, including six of the 10 covered by the latest report.

Another standard that is not well complied with is the one for severance pay. This calls for a minimum of two weeks' pay for each year of service. In the latest report only Owens-Corning Fiberglas complied. Four of the other nine employers were in substantial violation by averaging less than one week of pay for each year of service. For all 26 CPR reports, this standard has been complied with only 19% of the time. However, compliance with this standard has been gradually improving. For the past 10 reports it has averaged 30%.

The lowest long-term average compliance, 17%, is for the standard stating that rehire privileges will be carefully explained to terminees. In most cases, including nine of 10 in the latest report, this apparently is just not done. Eight of the employers investigated in the latest report state that their policies do not require the rehiring of those terminated before new employees are recruited.

On the other end of the scale of compliance is the standard calling for full pension vesting after 10 years of service. In recent years, this has almost always been complied with. Compliance rate of all 26 reports is 86%.

The standard stating that terminees should be helped in finding new jobs, either by internal transfer or outside, has been reasonably well complied with in recent years, including in six of the 10 cases in the latest report. Long-term compliance is 70%.

Compliance with the standard concerning extension of employee protection plans beyond the termination date has averaged 49% for all 26 reports. But this has been declining in recent years. Only 17 of the employers in the 62 mass terminations examined in the last seven reports have complied. In the latest report only two employers, Dow and Goodyear, met this standard.

Four of the employers investigated in the latest report met the standard calling for advance notice of a minimum of four weeks. This is in line with long-term compliance that averages 39%. □

1988 dues bill

If you have not received your 1988 dues bill or have questions about your bill, please call (614) 421-3776. To charge your payment by phone, call toll free (800) 227-5558, or in the Washington, D.C., area, call (202) 872-8070. Questions on the ACS credit policy should be directed to Earl Klinefelter, head of the Membership Activities Department, at (202) 872-4372.